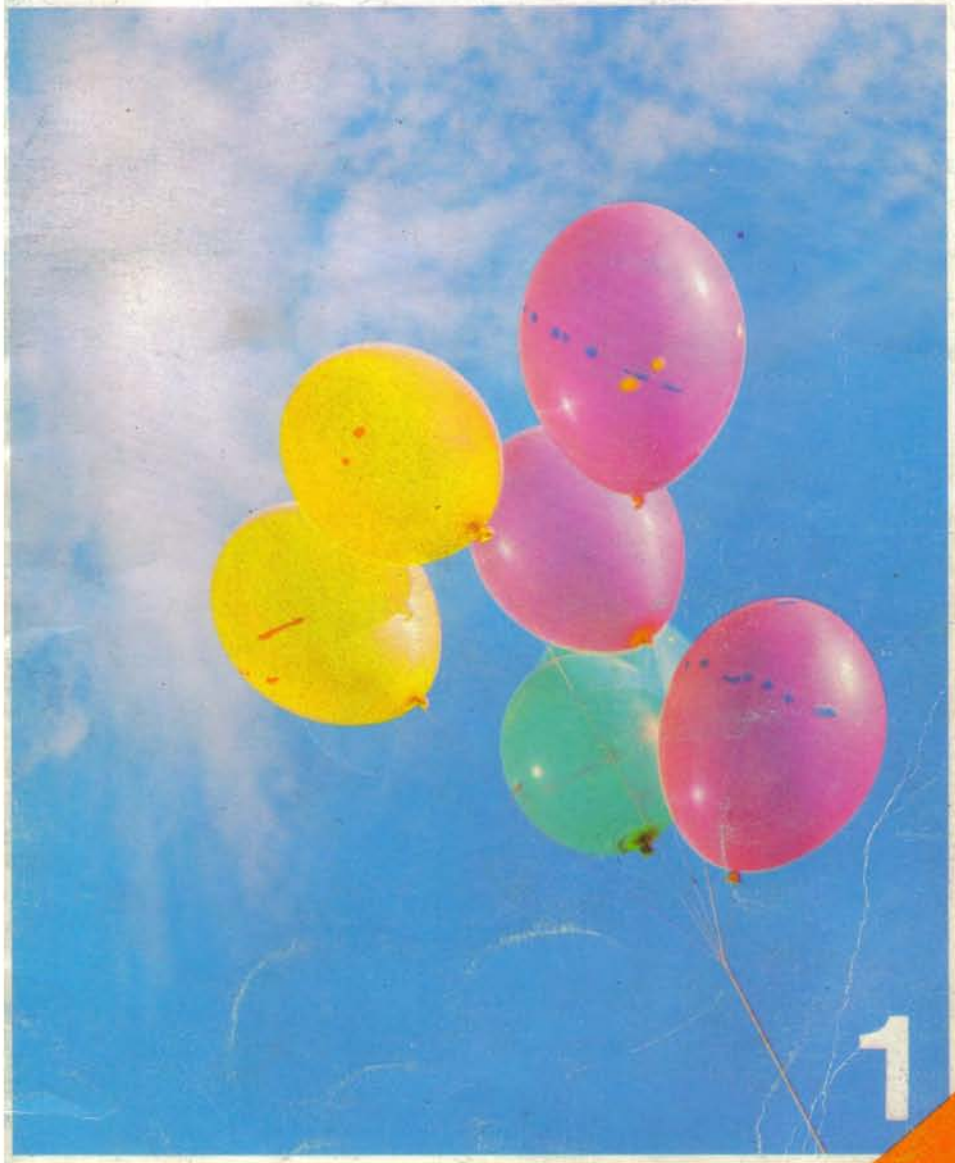
BASIC SCIENCE SERIES



1

AIR

REVISED EDITION

BASIC SCIENCE SERIES — BOOK 1

(2/82

REVISED EDITION

AIR

GREAT WESTERN PRESS PTY. LTD. — SYDNEY
Accra · Bangkok · Hong Kong · Karachi · Kingston · Lagos
London · Manila · Nairobi · Petaling Jaya

BASIC SCIENCE SERIES

1 AIR
2 EARTH
3 ELECTRICITY
4 FORCES AND MEASUREMENTS
5 HEAT
6 LIGHT
7 LIVING THINGS — ANIMALS
8 LIVING THINGS — MAN
9 LIVING THINGS — PLANTS
10 MAGNETISM
11 SOUND
12 WATER
13 ANIMALS AND THEIR YOUNG
14 SPACE AND MAN
15 LIFE IN THE SEA
16 ATOMS

123456789S98

Published in Australia 1978 by Great Western Press Pty. Ltd.,
71 Archer Street, Chatswood, N.S.W. 2067.

ISBN 0 86901 005 0
ISBN 0 86901 006 9

Printed and bound by
FEP International Private Limited, Jurong, Singapore.

PREFACE

In the present technological era it is important that all children should be given a basic training in scientific knowledge. The Basic Science Series is written with this aim in mind.

The series includes 16 scientific topics each of which is a complete information book. In its entirety the scheme covers the syllabus generally adopted by upper primary classes and lower secondary forms.

The text is supported by attractive illustrations and is written in a style acceptable to a wide range of pupils.

A strong feature of each of the books is the inclusion of many simple experiments under the section "Things to Do". This encourages the pupil to keep his own project book and ultimately assists his understanding of Science.

CONTENTS

THE ATMOSPHERE

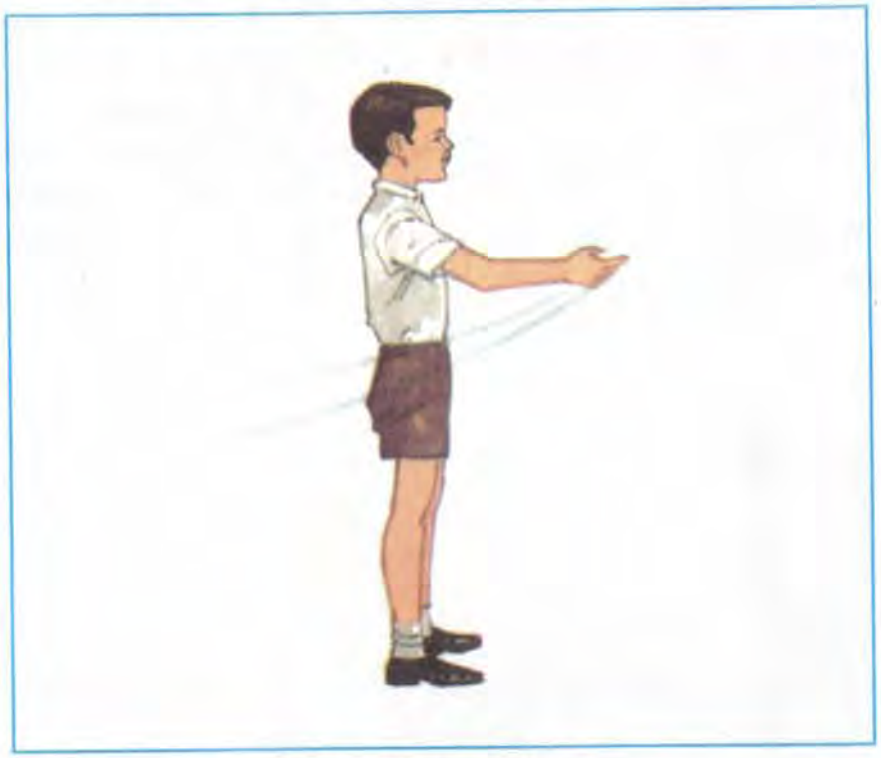
Our Earth is surrounded by a layer of air called the **atmosphere**. The atmosphere surrounds the Earth completely and is about 900 kilometres thick. Without the atmosphere, we would not be able to live on the Earth. There would be no air for us to breathe. The Earth would be very, very hot in the day and very, very cold at night.

The atmosphere

Things to Do

(i) Stretch out your hand in line with your shoulders. Swing it quickly round. What can you feel?

What you felt is the air. We cannot see the air but we can feel it. We feel it



Air is all around us.

when it is moving. We can also feel it when we move in it.

(ii) Now take a piece of paper in your hand. Swing your hand round again. You can see that the piece of paper is bent when your hand is moving.

Air pushes against things.

The air pushes against things when they move in it. It pushed against the paper when it moved. That is why the paper became bent when you moved it. You can feel the air pushing against you when you are in a moving car. You can also feel it when you cycle or run.

When air moves, it is called a **wind** or **breeze**. Sometimes the air moves very fast and causes a very strong wind. A strong wind can destroy things. It can blow down trees and houses.

DO LIVING THINGS NEED AIR?

Air is all around us. It is around us as we walk and play. From the moment we are born, we are surrounded by air. When we sit down, it is around us. When we go to bed, air is also around us. Wherever we are on Earth, we are surrounded by air. We live in air.

All living things need air. Living things cannot live without air. We can go without food or water for a few days, but we cannot live for more than a few minutes without air. We breathe in air. When we are working or

Plants need air to live.

Animals also need air to live.

running, we need more air. So we breathe faster than usual. When we are asleep, we need less air.

AIR OCCUPIES SPACE

When you pack your bag with books, your books occupy some **space** in your bag. If you ask your friends to put their books in your bag, there will come a time when no more books will enter your bag. This is because all the books occupy space and the space in

your bag is not big enough for all the books to enter.

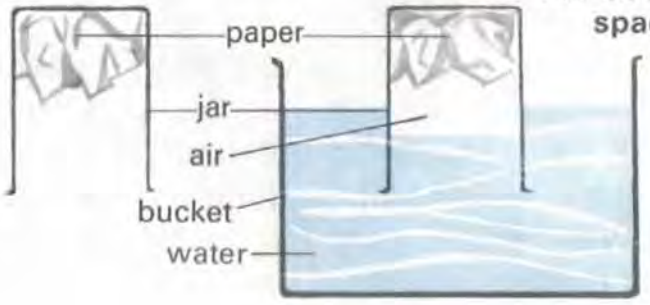
All things must occupy space. Air too occupies space. We cannot see air, so how do we know that it occupies space?

Things to Do

Let's find out if air occupies space. Crumple a piece of paper, and put it in a jar such that when you overturn the jar, the paper will not fall out.

Fill a bucket with water and slowly push the jar upside down into the bucket of water. Make sure the jar is upright all the time it is being pushed down. Do not tilt it. Do you see water entering the jar?

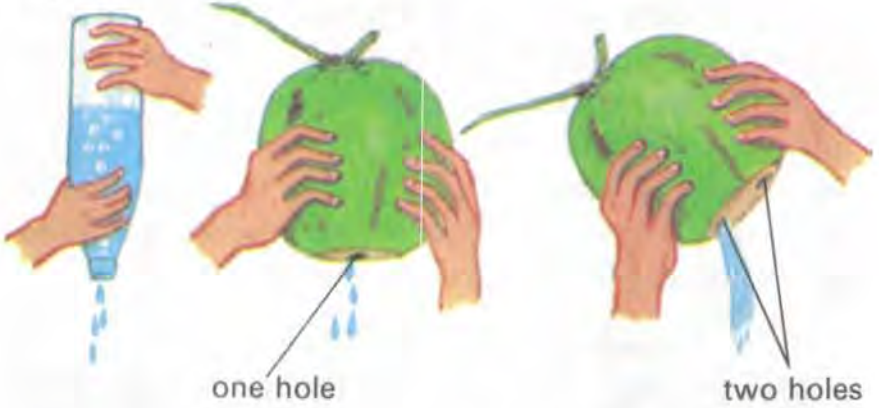
Now remove the jar from the bucket of water and examine the piece of paper. Is it wet? The paper remains dry because water did not enter the whole jar. Air was in the jar and it prevented the water from entering the whole jar. This shows that air occupies space.



Air occupies space.

AIR CAN TAKE THE PLACE OF LIQUIDS

If you fill a bottle with water and turn it upside down quickly you will see that, as the water comes out of the mouth of the bottle, large bubbles of air rush in to take the place of the water. Does this happen with other liquids?



Can air take the place of water and coconut 'water'? Why is it easier to pour the 'water' out of a coconut with two holes?

Things to Do

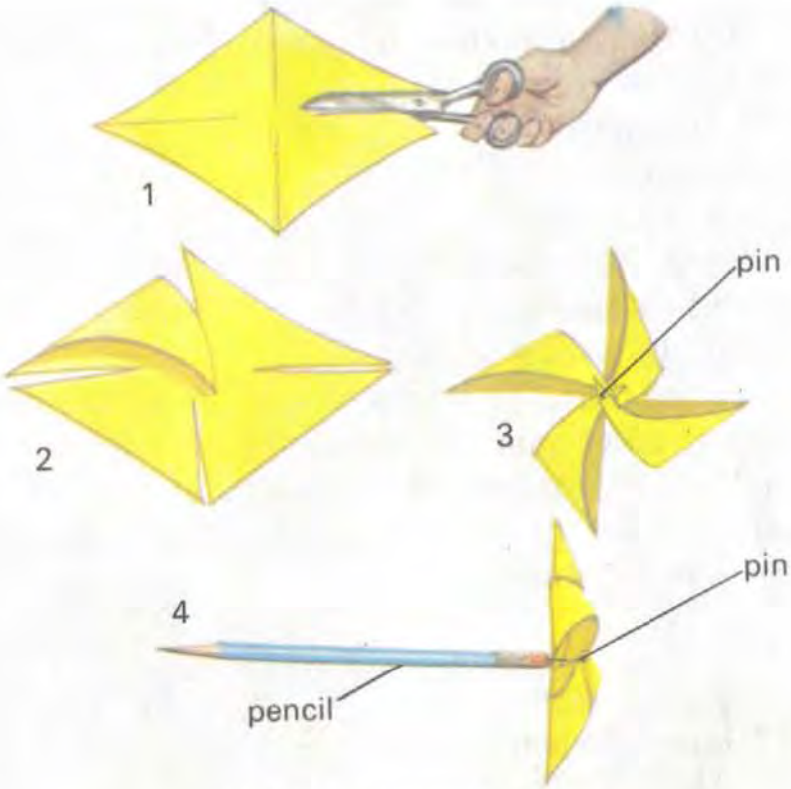
Take a coconut. Make a hole in it. Try to pour the 'water' out of the coconut. Can you do it? Now make another hole not too close to the first. Pour the 'water' out of the coconut. Are two holes better than one for pouring 'water' out of a coconut? Yes. As the 'water' comes out of one hole of the coconut, air rushes in through the other hole to take the place of the 'water'.

MOVING AIR

Moving air is called wind or breeze. How can you make air move? Here is one way. Hold an open book in your hands so that it faces you. Close it quickly. Do you feel the wind?

Sometimes the air moves very fast and causes a very strong wind. A strong wind can blow down trees and damage houses. The wind can do many useful things too. It works windmills and moves sailing boats. It helps to scatter the seeds of many plants. The wind helps to keep us cool. The wind produced by fans cools the engines of many machines.

Moving air works windmills.



Making a pinwheel

Things to Do

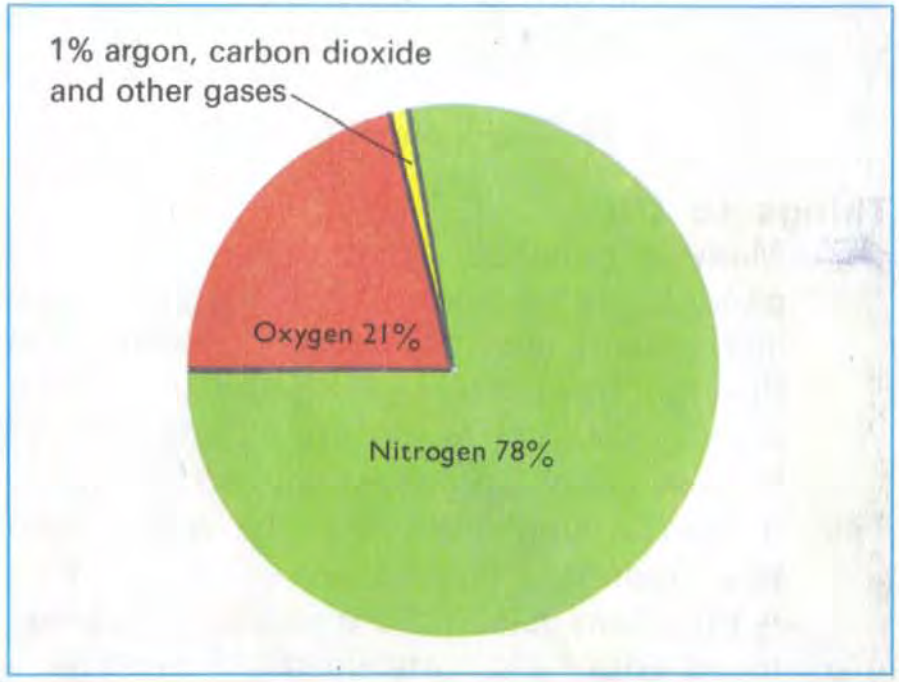
Make a pinwheel by marking a piece of paper as shown above. Then cut along each line. Bend over the corners. Push a pin through the centre. Push the pin into a pencil. Can you make the pinwheel turn? In how many different ways can you make it turn? One way is to blow air from your mouth. Another way is to fan it. A third way is to hold it in your hand and move your hand very quickly around you.

WHAT IS AIR MADE OF?

Dry air is a mixture of gases. Dry air contains by volume:
78% nitrogen
21% oxygen
about 0·7% argon
about 0·3% carbon dioxide and other gases.
In tropical countries, the air is moist and contains about 3% water vapour.

Notice that 21% or about $\frac{1}{5}$ of the air is oxygen. Plants and animals cannot live without this oxygen. Plants also make use of carbon dioxide gas in their green leaves to make food when the sun is shining.

The composition of air



Air is necessary for burning.

IS AIR NECESSARY FOR BURNING?

You have learned that we cannot live without air. We need air in order to live. Do you know that fires too need air in order to burn? If there is no air you would not be able to make a fire.

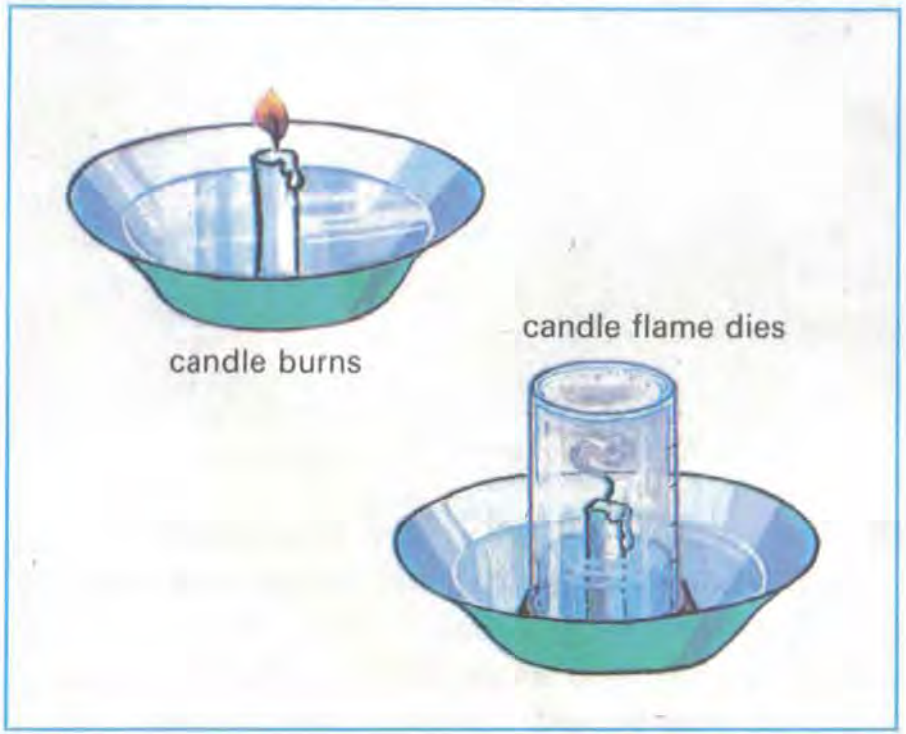
Things to Do

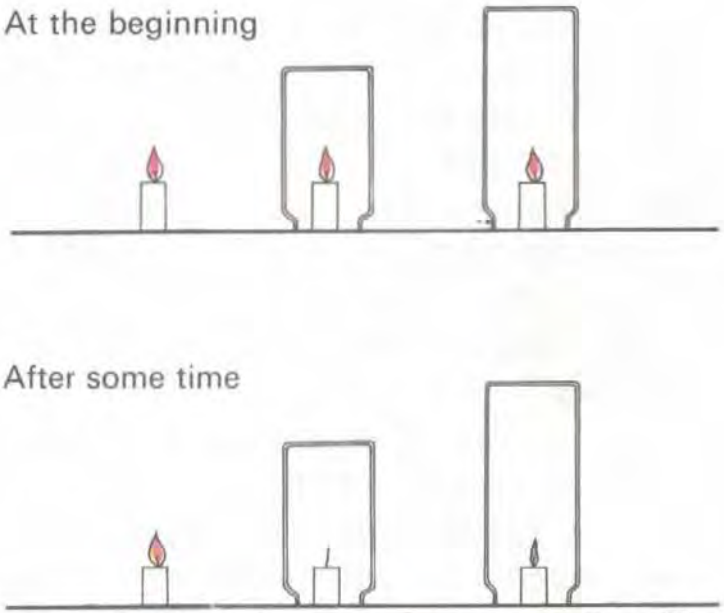
(i) Place a lighted candle in a dish of water and cover it with a glass jar. The candle will continue burning for a short while and then die out. Do you know why?

The water in the dish will prevent air outside the jar from entering the jar. The candle continues to burn for a short while because there is air inside the jar. But when this air is used up the candle flame dies.

This shows that air is necessary for burning. We can also show that the more air there is, the longer a candle will burn.

To show that air is necessary for burning





The more air there is the longer a candle will burn.

(ii) Take three candles of the same size and two jars, one bigger than the other. Stand the three candles apart and light them. Allow the first one to burn in the open, cover the second one with the smaller jar and the last one with the larger jar. Which candle flame dies out first? Which candle continues to burn? What does this show?

(iii) Take two sheets of paper which are about the same size. Burn one sheet of paper first. How long does the paper take to burn to ashes? Next, crumple the second sheet of paper and burn it. How long does the crumpled sheet of paper take to burn to ashes?

The crumpled paper would take a longer time to burn. This is because the flat sheet of paper gets more air than the crumpled paper.

(iv) Pile some sand on a piece of asbestos. Place a sheet of paper on the sand and then cover the middle part of the paper with more sand. Set the sheet of paper on fire. What happens?

The edges of the paper will burn to ashes. The part of the paper covered by sand will not burn. This is because the part covered by sand does not get any air.

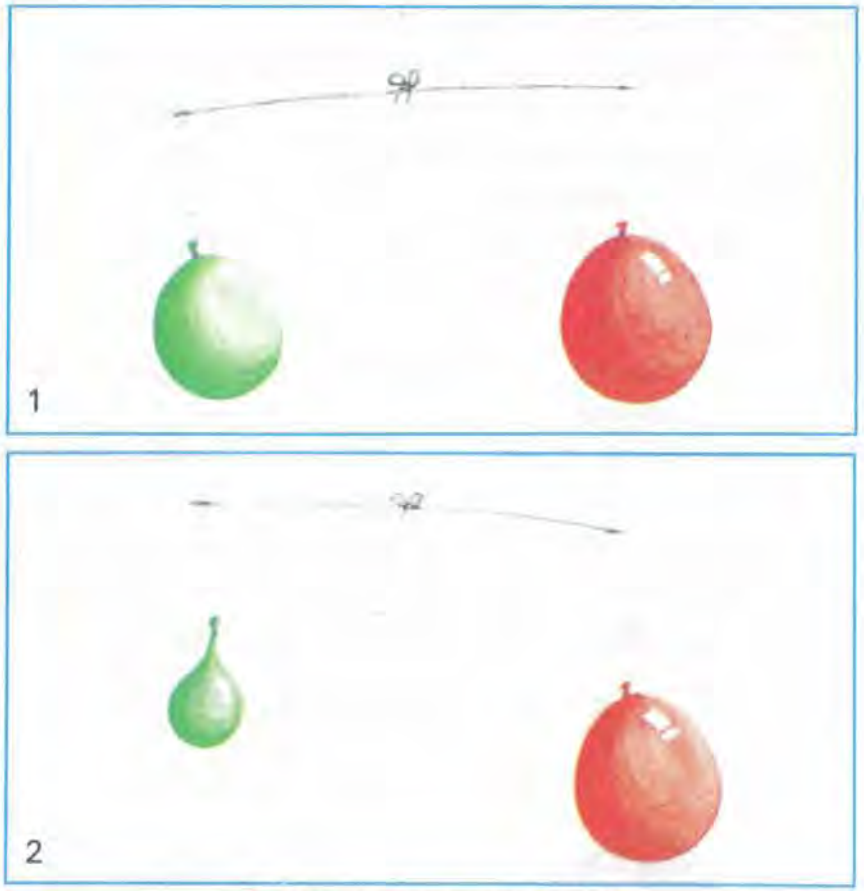
AIR HAS WEIGHT

We have learned earlier that air is around us everywhere. We cannot see air but we can feel it. We know that air occupies space. But does air have **weight**?

Things to Do

Take a piece of stiff wire or a stick about one metre long. Blow up two balloons until they are quite big. Tie strings to the neck of each balloon. Now tie one balloon to each end of the stick.

Tie another piece of string to the middle of the stick. Hold the stick with the balloons by this piece of string. The stick may not balance. Move one of the balloons along the stick until it is balanced.



Does air have weight?

Take a pair of scissors and cut a small slit on the neck of one of the balloons. The air escapes slowly. (Do not cut a large part of the balloon and burst it.) After all the air has escaped, see what happens to the stick. Does it balance now? Which end of the stick is heavier now? Why is this end heavier? Does this show that air has weight?

COMPRESSED AIR

When the air in a certain space is squeezed to occupy a smaller space, the air is said to be **compressed**. Compressed air in a ball gives it 'bounce'. Compressed air in bicycle tyres supports the weight of the bicycle and the rider.

Things to Do

(i) Pour some soap solution into a container. Dip one end of a straw in the solution. Blow gently through the straw. A soap bubble forms. What happens when you keep on blowing? The bubble bursts because the pressure inside the bubble is more than the pressure outside the bubble.

Blowing soap bubbles

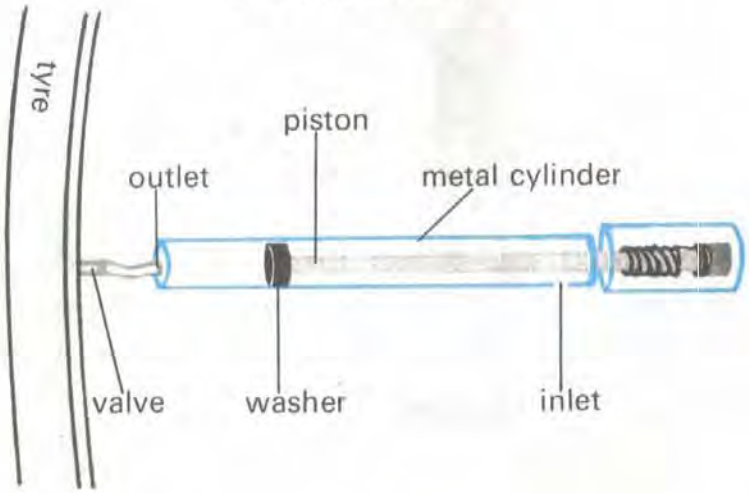
(ii) Obtain a bicycle pump. Release the air from one of the tyres of the bicycle. Connect the bicycle pump to the inlet of the rubber tube and pump air into it. Is there any difficulty in pumping the tube at first? Keep on pumping the tube. Is there any difficulty in pumping the tube later?

At first the air in the tube is not compressed. When the air in the tube becomes compressed, it will be difficult to pump more air in.

(iii) Take the bicycle pump apart and see the parts which it is made up of. The diagram below shows all the parts of the pump.

Invert the washer and put all the parts of the pump back. What can this pump do now? Can you pump the tyre now?

A bicycle pump



PRESSURE

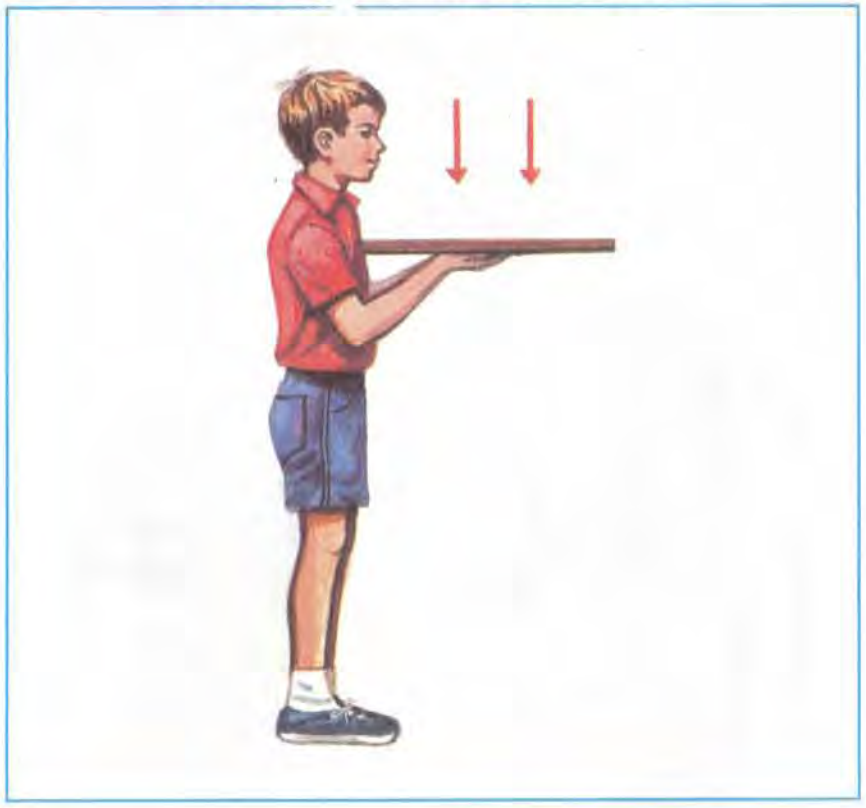
Anything which exerts pressure must have weight. What is the meaning of pressure?

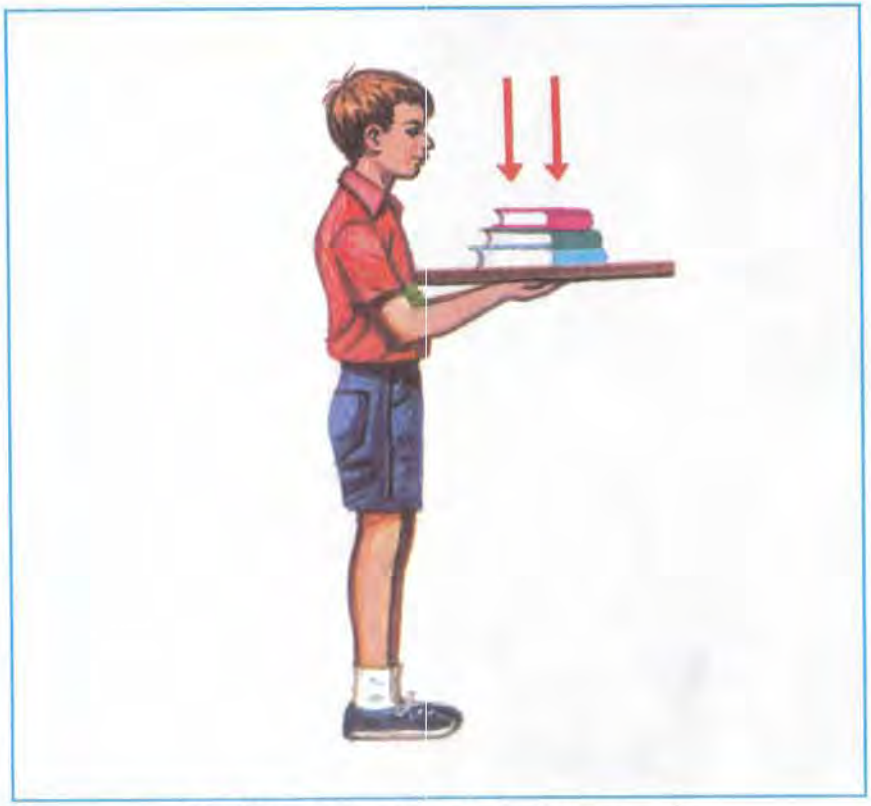
Things to Do

Take a piece of board. Lift it up. Is it easy to lift up? Now put some heavy books on the board. Lift up the board again. Is it as easy to lift as before?

The books you put on the board have **weight**. When these books are on the board, their weight

Does the board exert pressure?





Is the pressure greater now?

pushes the board downwards so that it is more difficult to lift it up. We call this **pressure**. We say that the books **exert** a pressure on the board.

Things to Do

Stretch out your hand and place a book on your outstretched palm. Can you feel a pressure? What causes the pressure? Tie a string to the book and hold the string with your fingers. Can you feel a pressure again? What causes the pressure?

A deep sea diver wears a suit which protects him from the pressure exerted by water.

Pressure is caused by weight. When you go swimming, you can feel the pressure of the water against your body. When you dive into the water, this pressure becomes greater. This is because more water is above you so that the weight of water above you is greater. It therefore exerts a greater pressure on your body.

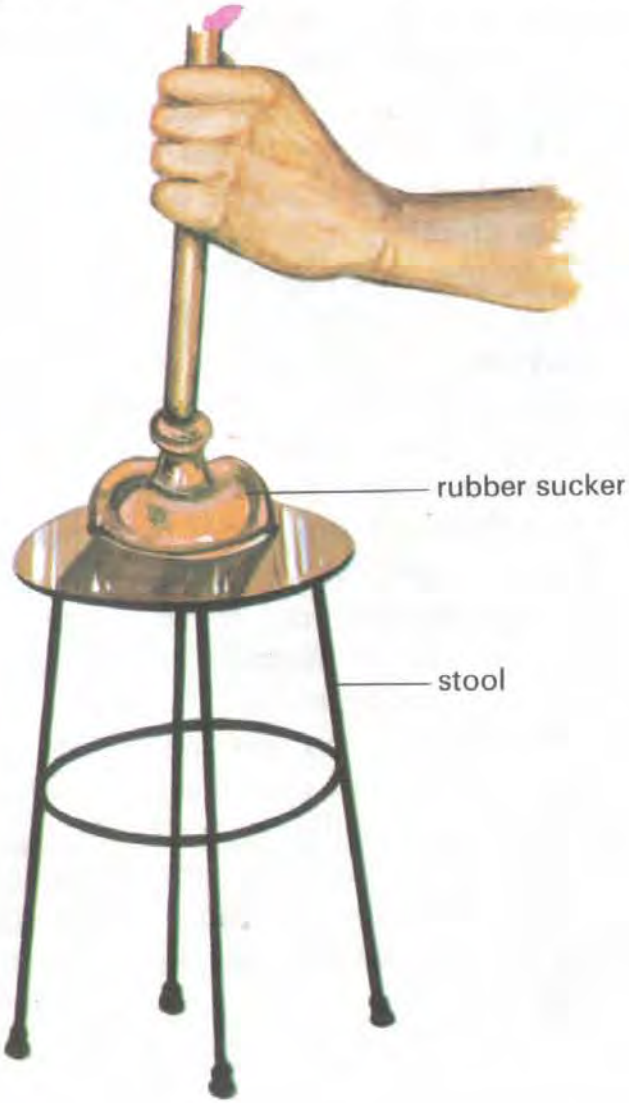
AIR EXERTS PRESSURE

We have shown that air has weight. We learned that anything which has weight can exert pressure. We can now say that air exerts pressure. We can show this easily.

Things to Do

(i) You will need a rubber sucker. The kitchen sink pump can be used as a rubber sucker. Wet the seat of a wooden chair or stool. Set the rubber sucker upright on the

Is it possible to lift the stool with the rubber sucker?



stool. Push the handle to flatten the rubber sucker. What happens when you flatten the rubber sucker? Is there air inside the rubber sucker now? Lift the handle and try to remove the sucker from the stool. What happens? What holds the rubber sucker to the stool?

(ii) Take a wide-mouthed bottle or jar. (A peanut-butter jar can be used). Pour some water into it. Float a small piece of cork on the water in the jar.

Next, take a wide glass tube. (The glass chimney of a kerosene lamp will do.) Close the wider end of the glass chimney with your palm. Push the other end downwards over the floating piece of cork. Do not let air escape past your palm. What happens? Why does the water in the chimney not rise to the same level as the water in the jar? What can you feel on your palm?

Now remove your hand and allow air to escape. What happens to the water level in the glass chimney?

What can you say about air pressure when the air in the chimney is forced to occupy a smaller space? When air is forced to occupy a smaller space it is said to be compressed. What can you say about compressed air when it is set free?

Does compressed air exert pressure?

(iii) Fill a drinking glass completely with water. Allow some water to overflow. Now place a piece of waxed paper (or cardboard)

Why does the paper stick to the glass? Is it due to the water inside the glass or the air outside the glass?


1


2


3

on the top of the glass. Make sure that there are no air bubbles. Turn the glass upside down quickly. When you do this, keep the waxed paper in place with your hand. Remove your hand from the paper and see what happens. Does the paper fall? What keeps the paper and water from falling? Carefully turn the glass in all directions. Is there any position in which the paper and water will fall? What does this show you about air pressure?

All the things that you have done show us that air exerts pressure. When the air from the rubber sucker was pushed out, outside air pressure pressed the rubber sucker to the stool. That is why the rubber sucker could not be pulled out. That is why the stool could be lifted.

In the glass chimney experiment, the air inside the chimney exerted pressure. This prevented the water from rising up to the same level as the water outside the chimney. But the air was compressed a little so that some water did go into the chimney. This made the air pressure inside the chimney greater. Compressed air exerts a greater pressure. Your palm could feel the pressure. When compressed air was set free, it **expanded**, that is, it occupied more space, and escaped. The pressure became less. That is why the water level inside the chimney rose when you removed your palm.

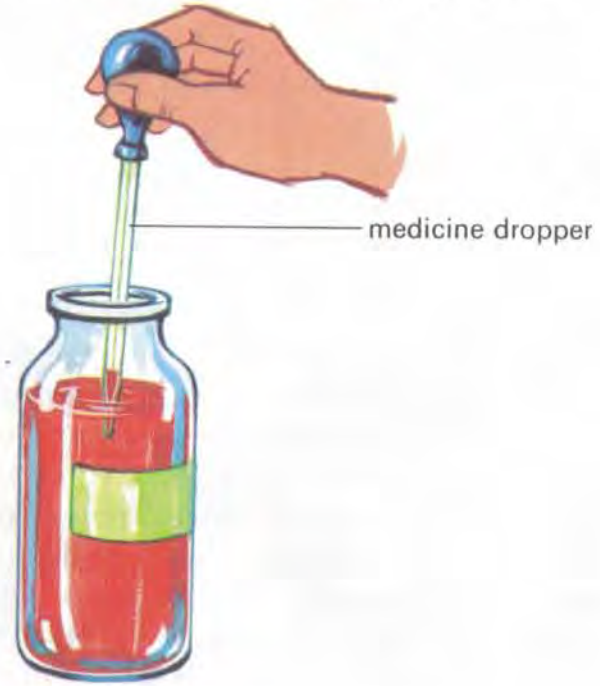
HOW TO MAKE USE OF AIR PRESSURE

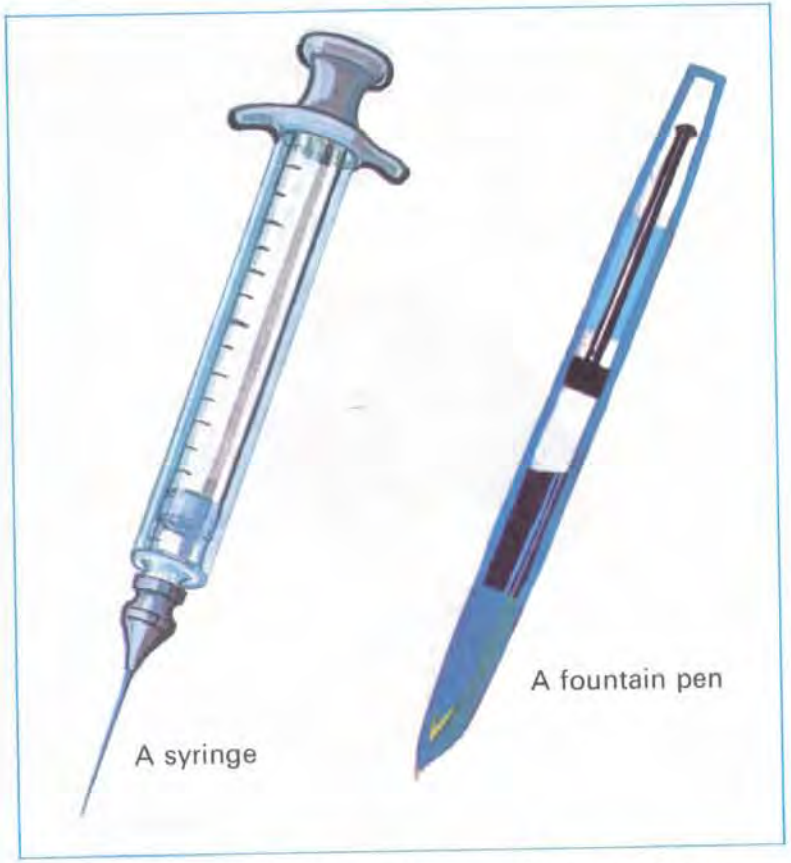
We make use of air pressure in many ways. Have you ever seen a **medicine dropper**? You can see it in the picture.

Things to Do

Take a medicine dropper and dip the tip into some water. Press the rubber bulb. What do you see? Release the bulb and see what happens. What makes the water enter the dropper?

To find out about the uses of air pressure



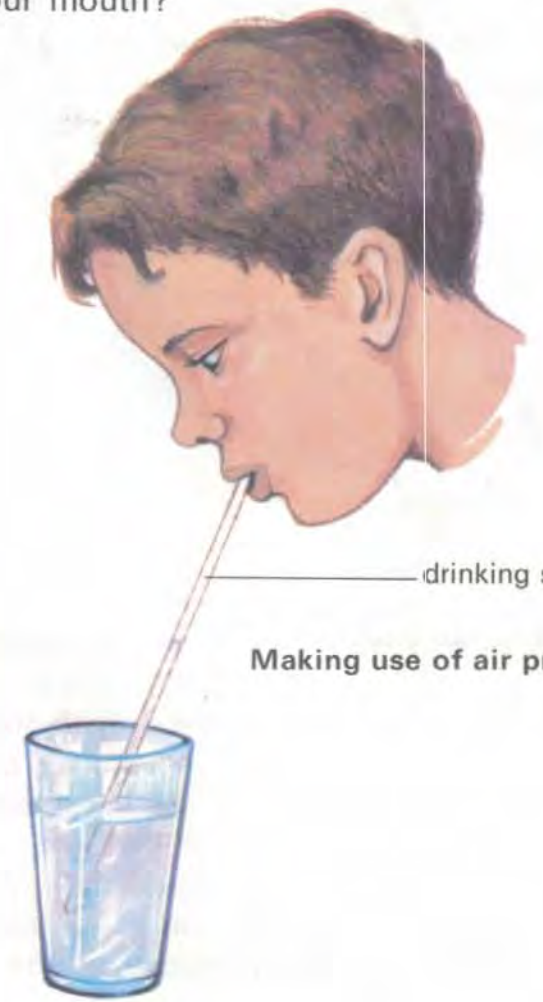


Instruments which make use of air pressure

The **fountain pen** is filled with ink in the same way. The piston drives the air out. This allows air pressure to push the ink into the pen. A **syringe** also works by air pressure. Doctors make use of a syringe for injections. When the handle is pulled out, air pressure pushes the medicine into the empty space in the syringe.

Things to Do

Drinking through a **straw** also makes use of air pressure. Put a straw in a glass of drinking water. Suck through the straw. What happens to the air pressure in the straw? Why does the water go up into your mouth?



Making use of air pressure